

reason. As the consumption of wheat per head in different wheat-eating populations varies a good deal, much may turn upon the nature of the increase, whether it is largest among the communities consuming wheat largely, or among the communities who consume little. To comprehend, in fact, the real growth of wheat-consuming power, we must have an average which allows for the different rates of consumption among the wheat-eating peoples, with references to the authorities for the statements as to each people. To set out this was of the essence of the problem Sir William Crookes had before him, and he has omitted it altogether. The nature of the increased consumption in each country should also have been investigated. It is asserted among farmers, for instance, that a considerable quantity of wheat, more than used to be the case, has of late years been taken in England for other purposes than the food of man, the wheat being given to cattle. Every one knows, again, that flour itself in domestic economy is more and more being applied as an element in cooking articles of luxury, and that it is not really used to a large extent as a principal food at all. All this adds to the interest of the problem as to any approaching shortage of wheat, and the means of making it good, because so much may at need be diverted back from other purposes to the primary use as food; and it shows also that the question of wheat consumption is not one that can be studied, for any such purpose as that contemplated by Sir William Crookes, without an infinity of detail. In any case, it was a matter of scientific good faith that he should have given the details and the references for the important statement we have quoted, which he has not done.

I am not making a mere formal objection. It is, of course, difficult to criticise without having before us the details which Sir William Crookes has not given, but I have not the smallest doubt that the largest increase of bread-eaters, which his details would show, is among the peoples consuming little per head, and not mainly among the peoples consuming much. One of the countries where wheat consumption per head is largest is France, and France is stationary in population.

Having made these general observations on the method followed in the essay, I do not feel called upon to go into detail respecting the actual acreage, and possible acreage, of wheat, in different countries, on which Sir William Crookes has so much to say. There is no question really more difficult. The capacity of a given population for agriculture is here just as much in question as the capacity of the soil, and I quite agree in principle with Sir William Crookes, that although additional soil might be available indefinitely for wheat in proper hands, yet as a matter of fact the soil practically available may be strictly limited. But what he fails to take sufficient note of, I believe, is the question of price. Land that would not be available for wheat with the price at 20s. to 25s. per quarter, might become available in indefinite quantities with the price at 40s. to 50s., and even 60s., which are by no means famine prices. But Sir William Crookes has little to say on this factor of price. Altogether, I may suggest, he relies too much on American statisticians, without having himself verified their methods. Mr. Davis for his purpose is not a

quotable authority. He should have gone behind Mr. Davis and verified everything for himself.

The point on which the reference is made is rather a side one, but the danger of putting forth a sweeping statistical statement without adequate support is so well illustrated by it, that it may be useful to quote it. Sir William Crookes states, p. 35:

"Taking the cost of producing a given quantity of wheat in the United Kingdom at 100s., the cost for the same amount in the United States is 67s., in India 66s., and in Russia 54s."

Surely it is altogether erroneous statistically to put forward a statement like this without references. How does Sir William Crookes know that England and the United States and the other countries mentioned differ so much as he states? The cost of production he refers to is either a maximum or a minimum, or a mean of two extremes, or an average; but which is it? As he makes the statement it is really unintelligible. If he means an average, as I presume must have been intended, how does he get the average? The statement is not one to be made in a scientific study without references and authorities, and full explanations of what is really meant.

In conclusion, I may express the hope that in some future essay Sir William Crookes will revise his present work, and not only look into his statistics, but inquire into the question of the play among different articles of food in agricultural production and in human consumption, instead of dealing with one article only. As to his suggested remedy for too little wheat, the fixing of the nitrogen of the atmosphere, it is one which may well be disconnected from the paper itself. Whatever may happen to wheat, the problem is one which should be attractive to the chemist on its own merits. It is, perhaps, unfortunate that the suggestion should have been appended to an alarmist statistical paper, instead of being made from the chemical side only, as the statistics seem to give little support to the suggestion.

R. GIFFEN.

THE PHYSICAL ATLAS.

Atlas of Meteorology. A series of over four hundred Maps prepared by J. G. Bartholomew, F.R.S.E., and A. J. Herbertson, Ph.D.; and edited by Alexander Buchan, LL.D., F.R.S. (Westminster: Archibald Constable and Co., 1899.)

OF the making of meteorological observations there is no end, and some, who have only a partial acquaintance with the subject, might be tempted to add, no result. But such a criticism, however smart, is eminently unjust, and as a protest against such an uncharitable opinion it was a wise and happy thought to endeavour to combine the outcome of the labours of many observers into a monumental form, which could appeal to the eye of many untrained in scientific methods, and convince them that time and thought and money had not been lavished in vain on mere childish records, but that earnest endeavour had harvested an abundance of facts, which only needed orderly arrangement and skilful grouping to make them available for instruction and edification. To the scientific mind well versed in such matters this compilation can appeal more strongly and more worthily, for it

demonstrates not only what has been successfully accomplished already, but exhibits the deficiencies that demand attention and offer prospects for hopeful exploration. These deficiencies will be mainly of two kinds. One, due to the dearth of information from sparsely inhabited districts in inhospitable climates, or from regions where no well-ordered government obtains. Such lacunæ are regrettable, but will gradually disappear in presence of individual enterprise, employing the same means as those which have been successful in more settled lands. The other is more serious, and may be traced to the want of greater originality in the construction and management of instruments devoted to particular ends. Imitation and repetition have probably been two of the main causes from which meteorology has suffered. We have been too content with the readings of barometers and thermometers in convenient positions, and have made but few attempts to investigate meteorological phenomena at elevated stations above the earth's surface, leading, it may be, to a knowledge of vertical gradients of pressure, temperature, humidity, &c., and suggesting new lines of useful inquiry. It may seem an ungracious remark with this collection of valuable facts before us, but it would appear that we have been too much engaged in recording the results of particular combinations of the atmosphere in particular districts, and too little concerned in the antecedent processes that have produced the effects we are so eager to register.

This existing wealth of meteorological observations makes us gratefully recognise the amount of labour that has been bestowed upon the production of this atlas. The task must have been a leviathan one, and it has been grappled with manfully. The meagre bibliography of four pages attached to the work, and which we cannot help regarding as somewhat unworthy of its place, can only very feebly indicate the sources of information that must have been consulted in the preparation of this record of the climate and the weather of the world. Scattered over many lands and described in various languages are valuable observations and memoirs, which it must have been the object of the compiler and his assistants to weld into this convenient form; and the eminent authorities who have associated themselves with the editor of this undertaking are a sufficient guarantee that all that is serviceable, all that is trustworthy, has been extracted from these hidden journals and memoirs. The general result is a collection of maps which are to a certain extent diagrams or the pictorial representation of much tabular work, and their study affords not only grounds for congratulation, but will tend to prevent unnecessary duplication and suggest the necessity for more strenuous and more scientific application of the methods open to us.

The atlas, consisting in all of thirty-four plates, is arranged to afford information on two distinct objects of meteorological inquiry, climate and weather—that is to say, variations of the atmospheric conditions for short and long periods. Under the first heading, climate, we have eight subdivisions. These are (1) isotherms, showing the seasonal and annual distribution of temperature over the world generally, and in greater detail for those countries where a sufficient number of observations exists to permit the lines of equal temperature to be drawn with exact-

ness; (2) isobars showing the distribution of atmospheric pressure, and arrows to indicate the prevailing direction of winds; (3) the relations existing between isotherms and isobars; (4, 5, 6) showing respectively the general distribution of sunshine, cloud and rain over the globe; (7) maps of hyetal regions and the seasonal distribution of rain; and (8) isobars and isohyets indicating monthly and annual distribution of barometric pressure and rainfall as related to each other for various countries.

It is impossible to enter here into details of the manner in which each and every of these subdivisions is treated, to discuss the principles which have guided the editor in constructing the maps and in overcoming the difficulties which naturally beset a diagrammatic representation. It goes without saying that the highest authorities have been consulted in the preparation, and, indeed, are to a certain extent responsible for the accuracy of the maps. These are executed in a very admirable manner, though sometimes the very neatness of execution makes it a little difficult to rapidly grasp the detail printed on them. As a rule, successive changes in the climatic element are shown by more intense washes of the same colour; and we could have wished that this rule had been more uniformly observed, since no abrupt change, such as that suggested by a change of colour, distinguishes the gradual variation of climate with latitude. For example, there is no sudden change of temperature to the north or south of an arbitrarily selected isotherm, yet one passes on these maps from red to yellow and from yellow to green with startling suddenness, as though some new feature had been introduced.

The second main division, under the generic title “weather,” naturally deals with the atmospheric conditions which have to be taken into account in making a forecast whether for a shorter or longer period. Here possibly there is opportunity for the exercise of greater originality in the selection of the necessary material than in the earlier section, which deals simply with the direct results of observation. For the systematic study of anomalous weather is of comparatively recent growth, and the information, based as it usually is, on shorter series of observations made in districts where observatories are more sparsely scattered, is not so definite nor so precise as that which characterises the older observations made in climates which do not experience those typical storms whose careful study has been attended always with interesting, and generally with beneficial, results. In this section, if anywhere in the volume, some alteration may be necessary hereafter in the detail and arrangement, occasioned either by the deductions from more recent observations, or by greater generalisations due to theoretical application. But it is safe to say that a very admirable use has been made of the information that at present exists, and in the description prefixed to the maps will be found a careful summary, not only of the inquiries instituted by national bureaux, such as that of the United States with its widespread network of stations, but also of the individual researches of such physicists as Hann, Eliot, Van Bebber, Doberck and others whose names are household words.

The sections into which the editor divides the subject of typical and anomalous weather, or the groups under which our present knowledge of this subject can be

presented, are five in number. Barometric pressure of necessity plays the principal part in the arrangement and subdivision of the section. The maps are constructed to exhibit the pressure conditions which obtain in abnormally hot and cold seasons and months in different regions, those which produce recognised types of wind and weather, or accompany typical storms of all kinds. To these are added maps showing the tracks of storms and the distribution of storm frequency, with a final series showing typical distributions of deviations from the normal monthly pressure, upon the study of which the forecasting of the probable weather for a season will be based, as well as the distribution of the mean deviations from these normals. From this description of the contents of the two sections, it will be seen that the atlas is essentially a book of results. It summarises what has been already accomplished by patient effort and long-continued observation, and the result is encouraging. Mr. Buchan, who signs the introduction in his capacity of editor, contends—

"If the present state of the science [of meteorology] as regards the geographical distribution of results be compared with that of the other sciences, such as geology and the biological sciences, it stands second to none. None of these sciences can show such a world-wide distribution of precise results as are collected in this Atlas of Meteorology in illustration of the geographical distribution of temperature pressure, humidity, cloud, rainfall and movements of the atmosphere, with illustrations of their influence over, and inter-relations with each other."

How far this remark is justified must be left to the individual judgment of those who it is hoped will read and digest this first instalment of the Physical Atlas.

W. E. P.

THE NORTH AMERICAN SLIME MOULDS.

The North American Slime Moulds. By Prof. T. H. McBride. Pp. xvii + 231, and plates. (New York: the Macmillan Company. London: Macmillan and Co., Ltd., 1899.)

THE group of organisms known as Myxomycetes, or as Mycetozoa of De Bary and Rostafinski, has of late years received much careful study in the United States. In 1834 Schweinitz published his "Synopsis of North American Fungi," and his large collection of Myxomycetes has been recognised in that country as the standard authority for reference. In 1848 Curtis contributed articles to journals on the subject, and both he and Ravenel made extensive gatherings in the south-eastern States. Since that time American investigators, conspicuous among whom should be mentioned Prof. Peck and the late Dr. G. A. Rex, have done excellent work; new species have been discovered, and large collections have been made in different parts of the States. The professors of botany have brought the Myxomycetes into their course of instruction, and a literature has sprung up founded to a considerable extent on local research.

Prof. McBride, of the University of Iowa, has made an important addition to this literature in the work under notice. In an interesting preface he pays a well-

deserved tribute to the labours of Rostafinski, and we are glad to see that he founds his classification on the lines laid down in Rostafinski's monograph of the Mycetozoa, but he prefers the older name Myxomycetes for the designation of the group. In this he follows Dr. Scott in his admirable book on structural botany; at the same time, Prof. McBride fairly discusses, from a botanist's point of view, the claims that have been advanced for including them in the animal kingdom, and sums up by saying—

"Why call them either animals or plants? The Myxomycetes are independent. All that we may attempt is to assert their nearer kindred with one or other of Life's great branches."

From this standpoint, however, we do not think that the adoption of the name "slime moulds" is a happy one. If, as the professor remarks, their position is "a matter of uncertainty, not to say perplexity," and in the face of the high authority of Rostafinski, under De Bary's supervision, for the name Mycetozoa, an English translation of either word seems to be hardly needed.

The question of nomenclature is perhaps a more burning one in the States than it is with us, where De Candolle's law is very much accepted in practice.

Prof. McBride speaks warmly on the subject on p. 10 of the preface. Instead of adopting the earliest published specific name of a species in the genus in which it now stands, and giving as the authority the name of the person who first placed it in that genus (leaving the history of the first describer to be traced in the unfortunately necessary list of synonyms), he aims at giving the earliest published specific name, under whatever genus it appeared, giving as the authority the name of the first describer in brackets, followed by the name of the placer in the present genus. If an important object in appending the authority were to commemorate the name of the first recorder, we should agree with the professor, and as a matter of sentiment there is much to be said in favour of his view; but if the object in quoting the authority be solely to establish the identity of a species, apart from personal considerations, De Candolle's rule has the advantage of simplicity. The ideal conception of a uniform system of classification universally accepted appears to be unattainable, at least in the present generation, considering the strongly-held and diverging views which now prevail; but Prof. McBride has devoted much labour to searching the oldest records, short and incomplete as many of them are and compiled with the aid of imperfect instruments, and we cannot but admire the thoroughness with which he has endeavoured to carry out his principle.

When we bear in mind the wide variation which we find in many species that offer abundant material for observation, as, for example, in *Physarum nutans* Pers., the adoption of a main centre as the type and the description of diverging forms as varieties appears to be in accordance with the actual facts, and is of assistance to students. Prof. McBride, however, avoids the introduction of varieties, and therefore multiplies the species recorded in his work to an extent which may not meet with universal approval; but it is fair to note that in many cases he leaves the specific value an open question.